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Director of the Institute for Biological Research in The Johns Hopkins University, is one of the most famous of American scientists. His writings on the future of humanity as a result of his research in

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the United States Food Administration, and for many years he has been associate and contributing editor to scientific journals and reviews. From 1918 to 1925 Dr. Pearl was Professor of Biometry and Vital Statistics in the School of Hygiene and Public Health, Johns Hopkins University.

H. Gray

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TO BEGIN WITH

BEING PROPHYLAXIS AGAINST PEDANTRY

by

RAYMOND PEARL

The Johns Hopkins University

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1927

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TO

HENRY LOUIS MENCKEN

PREFACE

This little book began as a magazine article entitled "The Reading of Graduate Students" which was originally published in "The Scientific Monthly" (Vol. XXI, pp. 33-44, July, 1925). Its appearance developed a wholly unexpected amount of general interest, and requests for reprints, sometimes for thousands at a time, from the most varied sources.

I have been urged by old students, friends in all parts of the world, and persons I never before heard of, to expand the original article and give it the more general availability which book publication affords. After my genial publisher, Mr. Alfred A. Knopf, had repeatedly added his

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invitation to the others, I decided to take the freedom from laboratory duties and responsibilities offered by a holiday to do it.

For the kind of suggestions about reading contained in this book there is a distinguished precedent. An earnest young student once asked the great Sydenham for advice as to what he should read to lay a sound foundation in medicine. To which request the wise old epidemiologist answered, "Don Quixote."

The index I have tried to make readable as well as informative.

I am indebted to Dr. J. McKeen Cattell for permission to use the original article in the way I have, in the preparation of this book.

September xi, 1926
Willoughby Lake

RAYMOND PEARL

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TO BEGIN WITH

Interea solitudinem & reliquas molestias, consuetudine librorum, veterum amicorum, solabor; qui quidem hactenus nullo modo mihi defuerunt, fidemque & assiduitatem quam debent, diu noctuque prestant.

July 14, 1556 *Augerius Gislenius Busbequii*

PALO ALTO, CALIFORNIA

Chapter 1

WHY?

IT is a matter of record (Butterbrot und Schinken, *Geschichte der besch. Metaphysik*, xi, 296) that Socrates was accustomed to hand to each of his students a mimeographed *List of Required Reading*, along with the syllabus of the questions he proposed to ask at each session. And, to go back still further, is it not stated on authority which seems slightly dubious, I grant, but which may be sound, that the great Chinese emperor Fu-hi, who died in 2738 B.C., having invented matrimony, was reading on his death-bed a then just issued treatise entitled (I translate) *The Sixty-Nine Best Books*, now unfortunately lost?

And so it has gone down to our day. Sometimes the outpouring for the relief of this curiously contagious itch to tell other people what to read, which infects mankind, has been overtly labelled for what it is, as

Lubbock's was and this little treatise is. In other cases the medicine has been skilfully flavored to disguise its real savor and purpose. Thus did Burton practice in his *Anatomy of Melancholy*, also the elder Disraeli in the *Curiosities of Literature*, and, to come nearer to the Victorian-Coolidgean epoch, so also Thomas Love Peacock and Anatole France. But if the thing has been so often done, why do it again? Have the old medicines, still carefully preserved on our library shelves, no healing power left? And why should a mere biologist venture into so recondite a field?

The answer is simple and has already been implied. The whole thing is grounded in pathology. Such books as this are always engendered by a queer sort of illness, acute in respect of certain of its elements, but in others stubbornly chronic. In my own case the thing began with all the symptoms of influenza, and was so diagnosed and treated by the faculty. But the trouble was really of a far more insidious nature. While I was confined to the house with a congested respiratory tract within, and a multitude of books without, the virus which had probably long lurked

in my system found its favorable moment, and pencil and paper had to be fetched forthwith to save my life. Here was the chance to do an article which would stop forever the annoyance of students always wanting to be told what they ought to read. At it I went, with mounting fever, and finished in two days the magazine article out of which this book later grew. On the third day I arose an apparently cured man.

So far I believe this to be an accurate description of a typical case of this strange disease. But it is not a complete picture of the syndrome. It neglects what is really its most important feature, the underlying psychopathic element. This takes the form of an hallucination that all is not well with the world. In particular, the poor harassed patient firmly believes that the young are going wrong and need sympathetic and wise guidance, before the harm to them, and correlatively to all humankind, is irremediable. The horrid vividness of this hallucination is beyond description. When the disease is at its height the delusion is fed by every newspaper, every social contact, and especially and particularly every student.

The disease was well known to the ancients. The Emperor Shi Hwang-ti, who began his reign in 246 B.C., not only had it in its most virulent form, but devised and carried out the most drastic and effective measures for its treatment ever known. His *therapeusis* has never been improved. While the acute illness twisted his viscera he personally examined, one by one, all the books which existed in China, at the rate of 120 pounds by weight *per diem;* set aside on the book shelves of the palace those which seemed to him worth reading and burned all the rest. There is every reason to suppose that he would have been completely and permanently cured by this course of treatment, but for one unfortunate fact. A group of professors, presumably fearful of losing their jobs if Shi's purge was allowed to finish itself, formed an association to defeat his purpose by secretly holding out books he had ordered burned. Some 460 of them were caught in this nefarious and inhuman business, and put to death. So putrid were their juices that melons actually grew in winter on the spot beneath which their bodies lay buried (Giles, *Chinese Biog. Dict.* 653). A number of others were

banished for life. But some few super-smart assistant professors succeeded in concealing enough books, by bricking them up in walls and in other ways, so that poor Shi Hwang-ti's cure was never complete.

Turning now to the western world, and about two centuries later, Quintus Horatius Flaccus, whose mental health otherwise was as cheerfully sound as could be desired, unquestionably had our disease in a mild but chronic form. Did he not point out (*Epist. I. ii.* 27–30) that while our strenuous idleness appears to drive us to seek the art of enjoying life by dashing about in automobiles, airplanes and express trains, this boon is really to be found in " the regulation of the mind, and not in the whisking about of the body."

In the most virulent form of the disease the hallucinations always center about the defects of the present system of educating our youth. The victim sees, with the most extraordinary clarity, its debasing and even ruinous tendencies. At the same time there suffuses through his whole being a great glow of mingled belief and hope that something effective

can be done about it. Thus the Rev. Dr. Opimian, obviously suffering from a fearful attack, says (*Gryll Grange*, xix): "If all the nonsense which, in the last quarter of a century, has been talked on all other subjects were thrown into one scale, and all that has been talked on the subject of education alone were thrown into the other, I think the latter would preponderate." And again in the course of the same conversation: "Questions which can only be answered by the parrotings of a memory crammed to disease with all sorts of heterogeneous diet can form no test of genius, taste, judgment, or normal capacity. Competitive Examinations takes for its *norma:* 'It is better to learn many things ill than one thing well'; or rather: 'It is better to learn to gabble about everything than to understand anything.' This is not the way to discover the wood of which Mercuries are made. I have been told that this precious scheme has been borrowed from China; a pretty fountain-head for moral and political improvement: and if so, I may say, after Petronius: 'This windy and monstrous loquacity has lately found its way to us from Asia, and like a pestilential

star has blighted the minds of youth otherwise rising to greatness.' "

Just as there is apparently no time limit to be set for the origin of this strange malady, in however remote antiquity, so there is no geographical bound to its pestilential spread. Lately a member of the National Academy of Sciences of our own prosperous commonwealth, has made a study of the elections to that occasionally immortal, though self-perpetuating, group of professors, and has published the results in their *Proceedings* (xi, 757–760). He found that during the 61 years of the Academy's history it had elected but 43 persons — almost exactly 10 percent of the total number ever elected — at an age under 37 years at the time of election. The remoteness of such an age from anything that can possibly be regarded as extreme youth indicates that the Academy has always been sceptical about any rapid flowering of genius. But even allowing for this wholly natural reluctance of the already immortal to recognize similar qualities in the still mortal, which was as characteristic of the denizens of Mt. Olympus (*cf.* Lucian, *Deorum concilium*) as it is of

those of Mt. Wilson, this is not the whole story. Our investigator found that of these 43 men who succeeded in grasping the Grail before age 37, only 11 have accomplished it in the 40 years which have elapsed since 1884. This leads him to make the following remarks (*loc. cit.* 760): "It is easy to attribute the changing habits of the Academy relative to the election of young men to a growing conservatism of that body itself. That this is the sole cause I doubt. It is at least possible, and I incline personally to think it probable, that the increasing organization, standardization, mechanization and constant striving for efficient mediocrity in all our university and college life, which every thoughtful person has seen going on during the past 30 years, and which some have deplored and vainly endeavored to stop, is showing as one of its most dreadful effects the curbing and fettering of the progress of the really brilliant student. That some such idea as this is forcing itself upon many minds is indicated by the National Research Council's study of the problem of the brilliant student, under the direction of Professor C. E. Seashore and by Professor Wheeler's bril-

liant paper on " The Dry-Rot of our Academic Biology," (*cit. infra,* No. 33). Much ink has been spilled about the subject of academic freedom, but nearly always with reference to the freedom of the professors to do various things, sometimes obviously absurd or ridiculous. Is it not about time to consider seriously the subject of the freedom, within academic precincts, of the student to develop his intellectual powers in the way he personally wants to? Perhaps some slight concessions in this direction would in time have as one result, among many other desirable ones, some lowering of the average age of election to the National Academy of Sciences."

Not only is the temporal and geographical incidence of our disease extraordinarily widespread, as we have seen, but it attacks persons of the most varied occupations. Anyone who knows anything about the forwardness and upwardness of the outlook of university deans, would naturally suppose them to enjoy a complete immunity from this loathsome infection. But under date line of Paris, September 2, 1926, we find the eminent Dr. Ferdinand Brunot, dean of the faculty of letters of the University of

Paris, quoted in the *Baltimore Evening Sun* to the following effect:

" The student coming from the *lycée* is about halfway," said the dean in commenting upon the throng of candidates from girls' schools seeking to enter the university. " She is evolving. How can we judge her? In the first place, there are too many of these students. And most of them are on the wrong road. A girl prepares her baccalaureate in Latin while she would do better in agriculture. The reason is bourgeois vanity. Parents from vanity want their children to gain an advanced education. They must be able, they believe, to answer affirmatively the question so often put today: ' Have you got your baccalaureate? ' We have lost the fundamental family education that used to be so valuable. Forty years ago the young man who spoke slang was rebuked in his home. But now the son of a dairyman or a concierge, who may make good grades in the *lycée* or the college, often uses when at home a language representing the worst taste and nobody corrects him. We can readily observe the effects of this in the examinations — so many papers smack

of the back-shop. In these papers on my desk are lines that are ridiculous. If they were published, they would be taken for the inventions of a humorist. In a single page of Latin we commonly find a dozen examples of bad spelling. We don't write French any longer because we don't speak it. That's the whole difficulty. The language established by the writers of the seventeenth century was that of the salons. Few writers knew French, but they wrote as they spoke, and their style was the purest and most measured in the world. We should not forget how our dictionary was made in 1694. The program of college instruction is badly chosen today. Students want above all to learn Latin, but if the student is talented it matters little what program he follows. We had an example this year when, in the general competition, the student who won the prize for dissertation did not know Latin. If parents were wiser, we could expect a great deal from their children."

These extracts from case histories must suffice for the exposition of the etiology and symptomatology of our malady. It remains to discuss briefly its treat-

ment. Here unfortunately the results are disappointing, and lag far behind the progress which has been made in its diagnosis. The most that the faculty has been able to accomplish by any treatment is the alleviation, sometimes permanent but more often only temporary, of the acute symptoms. Nothing has been found to produce any effect whatever upon the chronic element of the disease except Shi Hwang-ti's treatment, which violates the code of medical ethics and therefore cannot be used. Fortunately, like the gout, to which incidentally our disease has many other points of resemblance, it almost never is fatal. The patient is pestered, but not pinnated.

For the acute symptoms the treatment of choice, indeed the only effective one available, is to provide the victim with writing materials and let nature take its course, depending upon the *vis medicatrix scribendi*. The dosage should be sufficient. A magazine article is not enough. It will produce a slight remission of the symptoms, but the effect is never more than temporary. A book is almost always necessary in the end, and may as well be exhibited at once.

What follows then, in this book, is my medicine. I can think of no better apology for letting it go forth than the good-humored, if perhaps ironical, words of Georges Duhamel in one of his *Lettres au Patagon:*

> *" Toutes choses sont à leur place dans ce monde misérable, même le pathétique désir d'un monde meilleur."*

Chapter 2

WHEREFORE

IN theory, at least, that special kind of intellectual activity which we call graduate study and in so doing emphasize the least important of its milestones, should give its practitioner a comprehensive, justly balanced, and critically related knowledge of the particular field whose charms have seduced him. Perhaps I ought more precisely to say that this was the theory in my youth, and is still clung to by some.

But the prevalence and power of this view are unmistakably diminishing. This is perhaps chiefly because of the closer and closer integration of the advanced and graduate activities in our universities with the rest of the highly formalized and mechanized system of education which prevails in the land and is in such perfect accord with the cultivation of that efficient, standardized mediocrity which seems to be the very spirit and genius of American civilization. It is now quite possible, in fact it probably has been done, for a boy to go straight through from his letter blocks to his Ph.D. with precisely the same kind of coöperation in the enterprise on his part that a sardine furnishes to the business of his translation from the state of innocence and freedom of his birthplace to the diploma-bearing tin on the grocer's shelf. All that is requisite is a certain self-effacing conformity to a series of propulsive mechanisms.

Perhaps this is as it should be. Certainly he is a bold, if not indeed a rash, person who attempts to stand athwart the current of his civilization. But without being so extreme in the matter as this would imply the idea still somewhat widely prevails that,

without interfering in any important way with the smoothness of the established methods of manufacturing doctors of philosophy, and without curtailing the output of this commodity, it is desirable, and should be possible, to make the graduate student take a more active personal interest in the process of his transfiguration than the sardine may be presumed to. During the quarter of a century that I have tried to function as an insignificant cog in certain of the mechanisms referred to, the problem of how best to make those machines more useful has intermittently but still extensively engaged my attention. The instinct of workmanship is fairly deep-seated. We all like to do as good a job as we can. It has fallen out that my duties have been mainly to aid in the progress of graduate students along their appointed chutes. The problem has been: How may that basic ideal of graduate instruction stated in the first sentence of this chapter best be promoted? Not solely by lectures, it is generally agreed. There are two fundamental objections to this method; the first that it would make insufferable inroads on the professors' diversions, the other that it tends to perpetu-

ate the intellectual inertia begotten in the student's undergraduate course.

The only other way yet heard of to accomplish the end sought is that known as directed reading. The instructor is supposed to outline a course of reading for the student which will make him privy to at least the major secrets of his subjects. The advantages of this method are obvious. The student does something for himself. At its best he gets the sense of professional craft solidarity. He becomes really initiated into the realm of scholarship and makes contact with the great minds that have built the structure whose architecture he must know before he can add his bit to it. At the worst he has satisfied a requirement of the manufacturing process with a minimum amount of trouble to his instructor.

But granting the fundamental soundness of the pedagogical device of directed reading for graduate students, there still remains the problem for the instructor of determining on a general principle for the guiding of this reading. Obviously the student can not read in the three years of his graduate study as much of his subject as the instructor has in the,

let us say, *n* years of his professional life. A selection must be made from the treasures at command. But upon what principle shall this selection be made? It is this question which has vexed my mind, and I fancy that of many another in similar position. What I used to do was to make out lists of highly technical researches in the particular field of interest and tell the student that along that pathway was the road to salvation. This I am sure was a mistake. It started from a false assumption. The progression was forthwith to the special on the supposition that the general has been taken care of. But nothing could be more ridiculous nonsense than such an assumption. In consequence of the widely prevailing pedagogical theory that needlework, jigsawing, salesmanship and many other kindred academic disciplines are of at least equal cultural and intellectual value in the training of our youth to the study of Greek or Latin or mathematics or chemistry; coupled with the permission, if not active encouragement to the undergraduate to specialize during his mental infancy, it results that when the young things begin serious graduate work a solidly

grounded general background upon which to build a sound specialism is precisely what, generally speaking, they most completely lack.

What then to do? Plainly the obligation is to repair as much as may be of the damage that has been wrought from omission and commission, by putting in the way of the student the means of orienting himself relative to his subject on the one hand and to the general *corpus* of human learning on the other hand. If he amounts to anything he will then guide himself to the technical reading in his chosen subject better than any one else can steer him. If, by chance, he is not one of God's anointed, no harm will have been done. He will at least have glimpsed some little part of the evidence that

> Man's mind a mirror is of heavenly sights,
> A brief wherein all marvels summèd lie,

and in all probability will ever after lead a better life, even though he fails to become much of a biologist or statistician.

After thought, and the application of the method of

trial and error, I evolved the course of reading for my graduate students which it is the purpose of this book to exhibit. At the outstart it should be explained that the university students for whom this list was primarily designed are looking forward, for the most part, to careers connected in some manner near or remote with pure biology or with public health. Mainly they want to become qualified biologists or vital statisticians or biometricians. Some regard academic halls as the optimum environment for their souls' ultimate expansion; others look forward to a career of usefulness in an official bureau or an independent research institution. All intend, bless their innocent hearts, to become investigators, researchers, small or great as *Allah* may will, but anyhow members in good standing of the holy brotherhood of those curious to know. All these considerations have played their due part in the making of the list. But what has been of the greatest importance in determining its final constitution is that public health, vital statistics and biometry are all, when properly viewed, parts or branches of *biology*. Naturally, if one were making such a list for an

embryo physicist or chemist some of the items on the present would be replaced with others more directly pertinent to those lines of endeavor. But not all would be so replaced. A certain philosophical generality which taints and savors the list as a whole is perhaps its most engaging feature.

Let not the budding biologist suppose that he may with impunity omit the chapter devoted to statistical works, nor the embryo statistician think that he will lose nothing by skipping that which lists the strictly biological books. Virtually all biologists would be a great deal better off intellectually if they knew more than they do of the fundamentals of statistics. And a vital statistician who has not been steeped in the essential juices of biology is simply mis-labelled. He may be a statistician, but he is not likely to be particularly vital.

The list of books set forth in the remaining chapters of this little treatise is divided into four main parts on the following philosophy. Any person who intends to make his living and to spend his life at science plainly ought first of all to have the clearest possible understanding as to what science is and what it is all

about, in a broad philosophical and *human* sense. This means that he should have some notion of the main events in the history of human thought. Such an understanding should come early in the course of professional scientific study. Perhaps the student is embarking on a scientific career under a misapprehension as to what science really is. Such cases have been known. They are always sad and may be tragic. Hence Chapter III, " Underpinning."

Because a person, from however pure and noble motives, elects to be a worker in science he is not thereby absolved from the duties and privileges of being human. He must work out an adjustment between the claims upon his life of his science, a proverbially jealous and exacting mistress, and those of the rest of the world, including not only deans, committees, commissioners, directors, boards, foundations and other great cosmic elements, but also cooks, maids, nurses, children, and most important of all, his wife. While no one else can make these adjustments for him, still it will help to know how others have met the problem. Again if our graduate student, in whose behalf we are taking all this

trouble, turns out to amount to much he will sooner or later receive offers for the purchase of his soul. Such offers will be made by those skilled in the traffic and they will be tempting. A little knowledge of the technique in these matters will not be amiss. Shall we not be derelict in our job of helping our student to get his training for life if we do not furnish him some insight into what wisdom is available about the making of these necessary adjustments between scientific research and the rest of life? I think so. Hence Chapter IV, "Living."

Since the central element of the whole enterprise is biological the presence of Chapter V, "Biology," needs no special explanation or argument.

Finally, and obviously, my student may be intending to earn his living by the practice of a particular scientific trade. Hence Chapter VI, "Biostatistics."

I attach great importance to the order of the several items in the list. The maximum effect will be produced by reading them in precisely the sequence in which they are here set down, I believe.

* * *

So far in this chapter I have followed closely the magazine article, which was originally really intended only for my own university students. But, as has already been explained, that little paper attracted wider attention than had been expected or intended. It appeared that the general reader was interested in the list. Upon reflection this seemed reasonable. The "general reader," in so far as he reads more than the sub-titles of moving pictures, or that noble mirror of American civilization founded by Benjamin Franklin and theoretically published on Saturdays, is in fact a "graduate student." He has graduated from something. To be a student one does not have to be registered in a university.

So in revising and extending the original list I have kept this larger group in mind. And to safeguard this generalized graduate student I have marked with an asterisk those items in the list which can be guaranteed not to bite him. My meaning is that the starred titles in the first place presume no technical training in any particular science or philosophy, and in the second place are, on the whole, both easy and entertaining to read.

Chapter 3

UNDERPINNING

WITH this chapter the book list begins. For convenience each reference will be numbered consecutively, in the case of the books chosen for the definitive list. No attempt will be made to number casual and by-references in the text.

1.* *Titus Lucretius Carus: De Rerum Natura.*

At the beginning of Book IV Lucretius says: "I love to approach the untasted springs and to quaff, I love to cull fresh flowers and gather for my head a distinguished crown from spots where the muses have yet veiled the brows of none; first because I teach of great things and essay to release the mind from the fast bonds of religious scruples." This passage states clearly and precisely why this great book belongs at the head of our list. It is science alone which has freed mankind from the bondage

of priesthoods, and the superstitious fear of nature which is their sustenance. Lucretius was a pioneer in this noblest of all man's works, and he did it beautifully as well as soundly. In this connection I cannot refrain from interpolating a passing reference to the services in the same direction of a still earlier pioneer. Everybody who calls himself a man ought to read and reread Plato's *Euthyphro, The Apology,* and *Crito.* Socrates was undoubtedly a pest. Every right-thinking, forward-looking, one-hundred-per-cent Athenian regarded him as a dangerous nuisance who ought either to be deported or killed, and preferably the latter. If he were in our midst today he would meet a precisely similar fate at the hands of the Rotarians, Kiwanians, and other orthodox uplifters, that he did from the Dikastery. And for two simple reasons. He was a superior man and he was aggressively *attacking* Fundamentalism. *The Apology* is perhaps the noblest document the human mind has ever conceived. In it there is to be found none of that oily, nauseating striving to reconcile superstition with science as mutually compatible ideas, which is so much to the fore today. The fa-

miliar premise that Socrates was a man is right. He *was.*

Since few persons in this day and age can by any chance read in the original Latin Lucretius' superb poem about the problems with which science deals, I hasten to point out that the best English translation ever made is that by H. A. J. Munro, in connection with his definitive edition of Lucretius. It is readily available now in the Bohn Popular Library (New York: Harcourt, Brace & Co.). Munro was a remarkable man, a fellow of Trinity, who accepted in 1869 the first professorship of Latin ever instituted at Cambridge. But teaching bored him, as it has many another honest man, and he resigned the post after two years. His translation of Lucretius is a masterpiece, at once faithful to the text in a way that only a great scholar can achieve, and at the same time possessed of great literary charm on its own account.

If one wishes to have also at hand a metrical translation I can recommend the one by William Ellery Leonard, published in Everyman's Library (New York: E. P. Dutton and Co.).

2.* *Lucius Annaeus Seneca. Questiones Naturales.*

While not of anything like the importance of *De Rerum Natura* this treatise by Seneca on natural phenomena, particularly geological, meteorological, and astronomical, is useful at this point to help round out the picture of Roman science. Seneca was a great man, who furnishes the first example, in a long series, of the dreadful consequences of mixing science and politics. Undoubtedly the best translation for our purposes of this classic is that by John Clarke, entitled *Physical Science in the Time of Nero,* London (Macmillan and Co.), 1910. The translation is intelligently accurate. The edition is enhanced in value by the notes of Sir Archibald Geikie.

3.* *Aristotle. Historia Animalium.*

Beyond any comparison the best translation of this biological classic is that by D'Arcy Wentworth Thompson, which forms Volume IV of *The Works*

of Aristotle. Translated into English under the Editorship of J. A. Smith and W. D. Rose, Oxford (Clarendon Press), 1910. From the present point of view it is a pity that the annotations on biological matters are so meager in comparison with those on textual points, in this otherwise excellent edition. Gordon Alexander has recently (*Science*, March 13, 1925) called attention to a French translation of the *Historia Animalium* by Armand Gaston Camus (published in Paris, 1783) which supplies, by extensive biological notes, the deficiency mentioned in D'Arcy Thompson's translation.

4.* *Lawrence Joseph Henderson. The Order of Nature.*

This brief but important treatise will make it clear to the student, if it is not already so, why he has been asked to read the three preceding references. Further it will acquaint him early with *the* fundamental problem of science. The book is published by the Harvard University Press (Cambridge, Mass.), 1917.

5.* *Lucian of Samosata. Vitarum auctio* and *Piscator.*

These dialogues are included at this point to aid the student in properly orienting himself in respect of the rather weighty philosophical matters that have constituted so large a portion of his *pabulum* up to this point in the proceedings. He will find Lucian's account of the auctioning of the creeds, and its consequences, an agreeable corrective to any tendency towards mental coarctation or impedition which may have developed. While I refer here specifically to but two of Lucian's works, it is always to be hoped that this sample will whet the appetite for more, and that the student will read this too much neglected author extensively. For Lucian stands at the head of that small but choice succession of great human biologists who have clearly seen just how ridiculous an animal *Homo sapiens* is. The succession runs this way:

Lucian — Rabelais — Voltaire — Swift — Thomas Love Peacock — Anatole France — George Bernard Shaw — H. L. Mencken.

Regarding translations I can recommend as the raciest rendering of Lucian in English *The Works of Lucian of Samosata.* Translated by H. W. Fowler and F. G. Fowler, 4 Vols., Oxford (Clarendon Press), 1905. The volumes are of a handy size, and I find I take it from my library shelf oftener than any other edition. Its only fault is a somewhat heavier expurgation than robust biologists will find necessary. But it is always well to have a good many different editions of Lucian about, including at least one in French. (The one I happen to have is the Belin de Ballu translation, edited by Louis Humbert. It is a fine piece of scholarly work, with excellent notes. It was published in Paris (Garnier Frères), 1896, 2 vols.).

6.* *Alfred North Whitehead. Science and the Modern World.* [*Lowell Lectures, 1925.*]

In ending this book Whitehead says: " The moral of the tale is the power of reason, its decisive influence on the life of humanity. The great conquerors, from Alexander to Caesar, and from Caesar to Napoleon, influenced profoundly the lives of subse-

quent generations. But the total effect of this influence shrinks to insignificance, if compared to the entire transformation of human habits and human mentality produced by the long line of men of thought from Thales to the present day, men individually powerless, but ultimately the rulers of the world."

Perhaps the chief thing which inspires confidence that " Science and the Modern World " will prove with the passage of time to have been a truly epoch-making book is that so much of what it contains has been vaguely " in the air " of science and philosophy for some time past. The history of science shows that almost invariably really great ideas are a crystallization, as it were, out of a widely prevailing amorphous intellectual mother-liquor of the times. It is just this that Whitehead's book seems to me to be. It is, to be sure, in the highest degree original, but at the same time much of what it contains has been vaguely and indefinitely thought about by various people during the last twenty-five years.

Science and the Modern World was published in New York (Macmillan) in 1925.

7.* *George Henry Lewes. A Biographical History of Philosophy.*

This formed one of Sir John Lubbock's "Hundred Books." To this day it seems to me to be, by all odds, the best brief *résumé* of the history of human thought that has ever been written. It has literary charm and distinction. At the same time Lewes had the rare quality of real philosophical insight coupled with an even rarer skill in exposition. He gets the essential points and sets them forth in an orderly way. Persons who find philosophy hard or dull reading have never tried Lewes.

The book is not easy to get nowadays, because it has apparently not been reprinted for a long time. But by watching the second-hand catalogues it can be picked up without great trouble, either in some of the successive original editions or in the cheap reprint of the Lubbock "Hundred Books" (George Routledge and Sons, Ltd., London).

* * *

THE works listed up to this point may fairly be said, I think, to expose within their limits the field

of science as a whole in its philosophical meaning and relationships. He who has read through these seven titles can not fail to be impressed with the nobility and grandeur of the enterprise upon which he has embarked in deciding to devote his life to science.

We may next properly consider in some detail, but also with generality, the *method* of science.

8.* *Francis Bacon. On the Dignity and Advancement of Learning* and *Novum Organum; or True Suggestion for the Interpretation of Nature.*

Our student will talk and hear a great deal about the Baconian method. It is reasonable that he find out at first hand what was really said by the person called " Pecksniff Bacon " by Samuel Butler. Also his eyes will be helpfully (and widely) opened in various other directions by reading these two books. There have been many editions. *The Advancement of Learning* was originally published in 1605. One factor in its enormous popularity and influence was undoubtedly that it was the first great prose work on

a secular subject published in the English tongue. An excellent and quite easily available edition of the two works here listed is that in the series "The World's Great Classics," published in New York in 1899, by the Colonial Press. Both are included in a single volume.

9.* *René Descartes. Discours de la méthode pour bien conduire sa raison et chercher la vérité dans les sciences.*

This great classic on the method of science has been translated into many languages. The student may read it in any he likes. The edition which I have is the cheap reprint of the original French in the "Sir John Lubbock's Hundred Books" series published by Routledge, and already referred to above. It is edited by T. V. Carpentier, with an excellent biographical and critical introduction, and very useful notes.

10.* *William Whewell. The History of the Inductive Sciences.*

While never, so far as I am aware, characterized as light reading, there is nothing to this day to take the place of this treatise by the great Master of Trinity. A supplement or sequel to it ought to be done. It formed in Whewell's own mind only the first half of his *magnum opus*, but I have never had the courage — even if I had had the desire — to ask any young and cheerful student to wade through that preternaturally dull and in good part quite unsound book, *The Philosophy of the Inductive Sciences, formed upon their History*, which constituted the second half of the enterprise.

The *History* may be found without difficulty in most college and university libraries, and second-hand copies turn up fairly frequently at a moderate price. The first edition was published in three volumes, in London (John W. Parker) in 1837. There were several later revised editions, in which some additional material was incorporated. But for our present purpose one edition is as good as another.

11.* *Gustave Flaubert. Bouvard et Pécuchet.*

This I conceive to be one of the more important titles in the list. Its outlook on life and learning has many points of similarity to that of *The Education of Henry Adams*, but is a much more entertaining book. And at just this point, after the very solid meat of Whewell, something in the nature of a cacation is needed.

One of the most urbane and distinguished critics of this list has, from the beginning, objected to the inclusion of *Bouvard et Pécuchet*. The grounds alleged are two-fold. The first is that as literature it does not compare with Flaubert's great masterpiece, *Madame Bovary*. This I cheerfully grant, at once. But the criticism is irrelevant. My list is not based primarily upon literary values. If it were it would be quite different, as a whole. I shall have something more to say on this point in a later chapter.

The second point is at once more subtle and more entertaining. My critic is a most distinguished scientist, with a very high-toned class consciousness. He says that the satire of *Bouvard et Pécuchet* is unfair. Now, so far as I am aware this book is the most extensive and incisive satire ever directed

solely and specifically against science, not as such, but *as actually practised by its working professors.* It seems to be good enough to hurt. This, I think, justifies its inclusion in this list. And furthermore it *is* a vastly amusing book.

The student can easily get it either in the original or in English translation, according to his preference. The best edition is that of the *Oeuvres complètes de Gustave Flaubert,* published in Paris by Louis Conard (17, Boulevard de la Madeleine) in 1910.

12.* *Karl Pearson. The Grammar of Science.*

I like best the second edition. I am told by some of my friends that this is not a great book, that it lacks originality and fails in other ways I can not now remember. Perhaps so. I first read it the year I began graduate work. It produced at that time such an effect on my intellectual outlook as no other book I had ever read. Henry Adams reports that Willard Gibbs said he found it helpful. I know of no other single book quite so important for the student beginning graduate work in science to read. The pre-

ferred edition was published in London (Adam and Charles Black), in 1900.

13.* *Ferdinand Canning Scott Schiller. Formal Logic, a Scientific and Social Problem.*

Logic is a necessary part of the methodological equipment of the man of science. But it is in some respects the most tricky and dangerous tool in the box. The distinguished and urbane Oxford philosopher is a sound guide, with something original to say. *Formal Logic* was published in 1912 by The Macmillan Company.

* * *

When this point has been reached the student will have his foundation well laid and deeply. Before passing on to the next large subdivision he deserves entertainment and a broad sweeping view of the territory he has traversed, as well as that over which he has still to go. To supply this need the next three titles are offered.

14.* *Henry Thomas Buckle. History of Civilization in England.*

I am sure that Buckle is an under-rated figure in the history of human thought, and has been ever since he wrote. It has been the fashion among the learned to lay great stress on the errors he made, and generally to depreciate him, with a touch of derision or even contempt. The reason for this attitude is simple. Buckle never belonged to the Professors' Union. He was not only outside the academic pale, but openly gloried in the fact. Furthermore he was incomparably more original and clever than the professional historians of his time, and, indeed, of nearly any time, were accustomed to be. This combination of circumstances got him into trouble. It was thought necessary for the preservation of guild solidarity and prestige to spank him thoroughly, so that no other bright young boy or girl might be led to follow his example. The *History of Civilization* remains, however, an enduring monument. Not many books as interesting have ever been written.

15.* *Arthur Tilley. François Rabelais.*

This is an intercalation which theoretically ought not to have to be here. It is inserted simply as a preparation for the next item on the list. Many persons find it difficult to get anything like a proper appreciation and respect for the significance of Rabelais in the history of thought when they approach his works wholly unprepared. One needs to know something of his times and the circumstances of his life. Tilley's commentary is sound and helpful. The book was published in Philadelphia (Lippincott), 1907.

16.* *François Rabelais. Five Books of the Lives, Heroick Deeds and Sayings of Gargantua and his Sonne Pantagruel.*

Of this great classic there are innumerable editions. In the original it is difficult for any one not a specialist in medieval French. But the English translation begun by Sir Thomas Urquhart and finished by Pierre Motteux has become a classic on its own account. Of the various editions in my collection I will

mention only these: First the Navarre Society's two-volume edition recently issued, with illustrations by W. Heath Robinson. To those who know Rabelais and Heath Robinson further comment is unnecessary. The typography and printing of this edition are beautiful. But the volumes are too bulky for the travelling bag, and the edition lacks Motteux's notes, which are valuable. For everyday use I find a little five-volume edition published in London, edited by Alfred Wallis, to be convenient.

Because of its outstanding merits on its own account the Urquhart-Motteux translation is popularly regarded as the best. In one sense this is not true. By all odds the most faithful translation is that by W. F. Smith, *Rabelais. The Five Books and Minor Writings together with Letters and Documents Illustrating his Life.* Published for subscribers only by Alexander P. Watt (London) 1893. Except for five short passages, which are left in the original French, the translation is complete. It aims to say in English as exactly as possible, just what Rabelais said in French. Furthermore I believe it to equal, if not surpass, Urquhart and Motteux as English litera-

ture. Those great worthies so exuberantly fell into the spirit of Rabelais that, in many instances, they failed to stop when he did, but kept on piling up more of the same. The genuine Pantagruelist will want both editions. He will also want some French editions. A beautiful and altogether delightful little French set in four volumes is now in process of publication (or rather has just been completed) by *les Editions de la Sirène.* The volumes are charmingly illustrated by reproductions of old copperplates and woodcuts.

A useful and inexpensive volume for the Rabelais student is Jacques Boulanger's *Rabelais / a travers les ages / Compilation / suivie d'une / bibliographie sommaire / de l'oeuvre de Maître François, comprenant les éditions qu'on en a / données depuis le XVI*e *siècle jusqu' à nos jours / d'une / étude sur ses portraits / et d'un / examen de ses autographes / ouvrage illustré de plusieurs portraits et fac-similés.* Paris (Le Divan), 1925.

Chapter 4

LIVING

WE come now to an important and difficult division of our subject. At least it is difficult for the compiler, though I hope it will prove diverting as well as helpful to the reader. The difficulty in the case arises because of a sharp division of opinion as to what is the correct philosophy in the premises. The branch of science which underlies the art of conducting life is called ethics. Now there are those who contend that *experientia docet* is a completely inclusive proposition. Experience alone is held to teach anything worth knowing. There is much to be said in favor of this idea, particularly if attention on the other side be confined solely to the orthodox texts on ethics, labelled and recognized as such. Little which was at once new and of real importance has been said about ethics by the professors since Aristotle wrote the *Nicomachean Ethics*. At least it seems to me so. I have lately been studying that great work with considerable care, and at the same time have

been conning the subsequent history of the subject. This process has led to the conclusion I have stated. But if it be granted that the best way to learn how to live is to live, still I think no harm will be done by reading the books listed in this chapter. No recognized treatise on ethics is to be found in the lot. Nor is anything of a solemn nature. On the contrary the items which in any degree profess to give advice are few in number, and thoroughly larded with humor, conscious or unconscious. For the rest, I have adopted the plan of oblique discourse. The cited books exhibit the details of actual lives which have been valuable in the world, and brought happiness to the individual.

17.* *Baltasar Gracian y Morales. The Art of Worldly Wisdom.*

Just as Lucretius properly heads the list of *Fundamentals,* so any treatment of the conduct of life must start with the wise and worldly advice of that most urbane of Jesuits, Baltasar Gracian. He was born in Calatayud (Aragon) in 1601, and became

eventually a college president. He wrote several books of no importance, and one great one, *Oráculo Manual y Arte de Prudencia.* This book is unique in two respects. No other treatise ever written contains in so small a space so much real worldly wisdom. The genial old rascal missed no bets. Also no other book ever written is so insidiously subversive of all the stated principles of Christian ethics, while maintaining itself on the highest of moral planes throughout. Gracian is the transcendent — nay the *truly* miraculous — university president.

It is curious that the book seems to be known by so few persons nowadays. It has been in continuous circulation for more than three centuries, has been translated into virtually all civilized languages, and has been used as the foundation of much which is publicly supposed to be their own, by a number of philosophers of later date, some of whom have not scrupled at what seems indistinguishable from direct plagiarism. Yet the most widely learned person I know, or know of, had never heard of Gracian till I called his attention to the *Art of Worldly Wisdom.* In the magazine article out of which the present

book grew, I placed in this position Arthur Schopenhauer's *Parerga und Paralipomena,* and referred especially to the essay entitled *Aphorismen zur Lebensweisheit* and its translation by T. B. Saunders in his *Essays of Schopenhauer.* In that place I said: "The most important parts, for the present purpose, of the *Lebensweisheit* are given in this translation as "The Wisdom of Life" and "Counsels and Maxims." In steering a pleasant and successful voyage through the tortuous and perilous channels of the sea of life in the real world of today the student will find few guides so sound and practical as this essay, because it will clarify his vision as to where the perils lie."

I still stand by this recommendation, but would only point out that practically all that Schopenhauer said in the passages referred to is taken from Gracian. In fact Schopenhauer publicly acknowledged his debt to the *Art of Worldly Wisdom.* In the disordered state of my health when the original list was made up is to be found my only excuse for having overlooked old Baltasar, an injustice which I hope is now fully atoned.

The Art of Worldly Wisdom has been recently reissued (1924) in a new and delightful English translation, in the Golden Treasury Series, published by The Macmillan Company. This edition contains a biographical and bibliographical introduction by the translator, Joseph Jacobs, which is valuable.

18.* *Honoré de Balzac. Physiologie du Mariage.*

This entertaining book is not at all like what it is supposed to be by those who have never read it. Its title is misleading; I fear intentionally so. It is interesting to speculate on the vastness of the sums of money which booksellers have illegitimately made because of this fact. I estimate the total to be considerably above that of the War Debt. Balzac's thorough treatise will be found useful by young men and women, who are at once good-humored and full-humored, in achieving what is perhaps the most difficult regulatory adaptation which civilized man is called upon to make.

There are, of course, many editions of this classic. If an English text is wanted I recommend the edition recently published by The Casanova Society. It is a fine piece of book making and an excellent translation.

19.* *Henry Louis Mencken. In Defense of Women.*

This important contribution to the literature of human biology covers similar ground to that cultivated by Balzac in the work just cited, but Mencken is much more scientific, terse, incisive, and up-to-date. In the original form of this list I included as a separate item Mencken's *Prejudices*, Series I to IV inclusive, and said, what I now wish to repeat: "Along with some matter perhaps irrelevant to the present purpose these essays contain much ripe wisdom about the more important aspects of the technique and ethics of civilized living."

All of Mr. Mencken's books, so far as they are still in print, are published by the publisher of the present volume.

20.* *H. Warner Allen. The Wines of France.*

P. Morton Shand dedicates his *A Book of Wine*, London (Alfred A. Knopf), 1926, as follows:

"To my father
from whom I learned the appreciation of fine wine
and
to my son
in the fond hope that he may grow up to cherish at their just worth the piously binned treasures which three generations have been at pains to lay up for future inheritance and delight
and
in affectionate and grateful memory of the Rev. x y z, my former Division Master, who, during hours nominally devoted to the inculcation of the rudiments of geography, taught me, while still of comparatively tender age and by the sound old-fashioned methods of physical correction, so that they abide with me to this day, the names, order of precedence, and classic vintages of the world's Great Wines."

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PALO ALTO, CALIFORNIA

I personally know of but one * teacher in any American school, college, or university who could today adequately perform the pedagogic service rendered to Mr. Shand by the Reverend *x*, *y*, *z*. There may be more. But in any case the number available is infinitesimally small as compared with the need. I therefore appoint Mr. Allen to the nearly vacant professorship. The multiplication of his personality which the book accomplishes will enable him to serve wherever needed.

I have chosen Allen rather than Shand for the definitive place in the list, in spite of the more restricted field covered by the former, for two reasons. In the first place Allen's treatise is much sounder and deeper, in my judgment. His knowledge of his field is profound, and his taste impeccable. In the second place, the best wines of France are so far superior to the best of any other part of the world that the ground work of a sound knowledge of the subject may properly be laid there. Shand should certainly

* It should perhaps be said, to be entirely candid and fair, that the eminent and respected professor to whom I refer, has had exceptional opportunities by virtue of frequent and prolonged contact with French civilization, from early boyhood on.

be read in supplement to Allen. So also should Saintsbury's delightful *Notes on a Cellar Book,* published in London (Macmillan) in 1920.

The Wines of France was published in London (Fisher Unwin), in 1924. (New York, Brentano's).

21.* *H. W. Fowler. A Dictionary of Modern English Usage.*

If our young biologist becomes a professional he will have to do some writing. Perhaps he will want to anyway. And surely some of our generalized students will. The most practically helpful treatise known to me, on the technique of our difficult language is this book. While in form a dictionary, it is eminently readable, full of sly humor as well as authoritative advice. *The King's English,* written some years ago by the same author, in collaboration with his brother, F. G. Fowler, will also be found both useful and entertaining.

The *Dictionary* is published at Oxford (Clarendon Press), 1926.

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The five books which have just been cited are all the treatises specifically giving advice regarding the conduct of life which I care to recommend at this time and place. We turn now to the method of illustrative examples. In building up a useful working knowledge of human behavior there is much in favor of the same pedagogical method that has been found so valuable in other branches of zoölogy, the careful study of type specimens.

22.* *Henry Morley. Palissy the Potter. The Life of Bernard Palissy, of Saintes, his Labours and Discoveries in Art and Science; with an Outline of his Philosophical Doctrines, and a Translation of Illustrative Selections from his Works.*

We start our short series of types with one of the greatest human beings who ever lived. Bernard Palissy was born in 1509. He educated himself, by the process of travelling about, observing nature, and talking with philosophers of all sorts and degrees. About 1538 he married, settled in Saintonge, and devoted his life to the making of very beautiful

things, and to the scientific study of natural phenomena, about which he wrote a few choice books. His extraordinary career ended with the founding and successful operation of the first Academy of Sciences which Paris had ever known. Its lineal successor today is the *Académie des Sciences de France*. For his first series of lectures at his " little Academy " Palissy charged a dollar a head, and offered to return four dollars for every one paid in if any of his teachings were successfully contradicted. His independent spirit never grovelled, nor did his superb intellect stop discovering and creating, though his body and his soul were tortured. What a man!

Henry Morley's life of Palissy — a splendid piece of biographical writing — was published in London (Chapman and Hall), 1854, in two volumes.

23.* *Henry Morley. Jerome Cardan — the Life of Girolamo Cardano, of Milan, Physician.*

Cardan was, on the whole, probably the most distinguished mathematician and the most distin-

guished physician of his day. This combination should interest the budding biometrician. His life was quite as melodramatically thrilling as that of Benvenuto Cellini. Cardan was undoubtedly something of a rascal, but he was also a genius. The story of his long struggle for professional respectability, which was finally attained only to be immediately shattered through the idiotic behavior of a worthless son, is a ghastly tragedy.

Morley's life was published in format uniform with that of *Palissy the Potter.*

24.* *Sir David Brewster. Memoirs of the Life, Writings and Discoveries of Sir Isaac Newton.*

This biography is inserted primarily in order that the reader may see that the emotional behavior of even the greatest of scientific men can be such that detached contemplation of it arouses no admiration. Two individuals more completely unlike in some respects than Cardan and Newton probably never existed. But in certain human reactions to their work they were very like indeed.

The edition which I have was published in Edinburgh (Constable), 1855, in two volumes.

25.* *Sophia Elizabeth De Morgan. Memoirs of Augustus De Morgan.*

Augustus De Morgan was a remarkable man in a number of different ways. He was an entirely human and also humorous mathematician. As an exegete of the profundities and difficulties of mathematics he has never been surpassed. There were many sides to his nature. His *Budget of Paradoxes* is a classic of both literature and science.

There is a curious connection between items 22 and 25 on this list. De Morgan's son, William De Morgan, known now as a novelist, made his living as a potter. His pottery comes nearer than any modern thing to rivalling, in the same manner, Palissy's best.

Mrs. De Morgan's life of her husband was published in London (Longmans, Green), 1882.

26.* *Hugh Miller. My Schools and Schoolmasters, or the Story of My Education.*

My copy is of the 13th edition, and dated in Edinburgh (W. P. Nimmo) 1869. To our mentally and financially becoddled fellowshippees of the present day this book must seem like some prehistoric fairy tale. Hugh Miller's name is in no sense a great one in the history of science. But few lives have had a higher moral value than his.

27.* *Francis Darwin. The Life and Letters of Charles Darwin, Including an Autobiographical Chapter.*

If this life, with its perfect devotion to the highest ideals of science, does not prove an inspiration to the student, he is hopeless.

The original edition was published in London (John Murray), 1887, in three volumes. This was followed some years later, by the *More Letters of Charles Darwin,* in two volumes, by the same editor and publisher. The picture of the lives of two remarkable families is rounded out by another two-volume work, *Emma Darwin. A Century of Family Letters. 1792–1896.* This book was edited by Hen-

rietta Litchfield, and published in New York (Appleton) in 1915.

28.* *Henry Festing Jones. Samuel Butler Author of Erewhon (1835–1902). A Memoir.*

Samuel Butler was an extreme variant of the supposedly well-known human race, lying far out on the right-hand tail of the frequency curve. This fact alone would not entitle him to a place among our specimens, but his ideas have real value in the history of thought.

Festing Jones' memoir was published in London and New York (Macmillan), 1919, in two volumes.

29.* *Francis Galton. Memories of My Life.*

Galton was certainly one of the greatest naturalists who ever lived. My hero worship extends to only a few individuals, but Francis Galton sits serene in the center of the galaxy.

His autobiography can be procured from the publishers, E. P. Dutton and Co., New York. It was published in 1909.

30.* *Karl Pearson. The Life, Letters and Labours of Francis Galton.*
Vol. I. Birth 1822 to Marriage 1853. Cambridge (University Press), 1914.
Vol. II. Researches of Middle Life. Cambridge (University Press), 1924.

This great biography by Pearson is inserted in this list in addition to Galton's own autobiography because of its great technical value to the biometrician. It contains a wealth of suggestive ideas.

31.* *René Vallery-Radot. The Life of Pasteur.*

This biographical classic is easily available in either French or in the English edition published by Doubleday, Page & Company (Garden City, New York) in 1919.

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Room lacks for more specimens of really sapient human beings. There are many other matters which

must be covered in this reading list. But it is hoped that these few choice samples will develop a taste for biographical reading. We turn now to other considerations.

32.* *Anatole France. L'orme du mail. Le mannequin d'osier. L'anneau d'améthyste. Monsieur Bergeret à Paris.*

Our student may have thoughts of a career as a college or university teacher. He ought to know something of the inwardness of such a life. Never has it been set forth with greater insight, slyer humor, or more devastating satire than in these records of the fortunes of Professor Bergeret, his colleagues, and his friends.

These volumes are published in French by Calmann-Lévy. If one wishes to read them in English I can recommend highly the Bodley Head edition of Anatole France's writings, published at two and six-pence the volume, a marvellously cheap price considering the quality of the bookmaking.

33.* *William Morton Wheeler. The termitodoxa, or biology and society* (Scientific Monthly, February 1920, pp. 113–124). *The dry-rot of our academic biology* (Science, Vol. 57, pp. 61–71, 1923).

These two short papers have the same purpose in our scheme as the preceding, No. 32.

34.* *François Marie Arouet de Voltaire. Micromégas.*

This tale should be read frequently — it is short — from youth on, as a powerful protection against the ever-present danger of becoming seriously important — or importantly serious. This peril threatens all mankind, but especially professors and public officials.

While speaking about Voltaire it may be said that the reader is not to conclude, because only *Micromégas* is formally listed, that he is to end his reading of this great man at that point. *Candide* or *Zadig* will do him no harm at all. All of these intriguing,

if perhaps slightly subversive, romances will be found nicely printed in one volume of the series *Tous les Chef-d'oeuvres de la Littérature Française,* published in Paris by *La Renaissance du Livre* (73, Boulevard Saint-Michel). The title of the volume is *Romans choisis de Voltaire.*

35.* *James Branch Cabell. Straws and Prayer-books. Dizain des Diversions.*

To the end that the student may observe the working of the mind of an artist, and see the great similarities and small differences between original creative effort, in art and in science.
This book is published in New York (McBride), 1924.

36.* *William Graham Sumner. Folkways.*

This great book may fittingly bring to a close the chapter on the conduct of life. It offers no advice. But it exposes in complete nudity and objectivity the bases of human behavior. It is an interesting com-

mentary on the state of civilization in the Era of Coolidge, that this book, which is undoubtedly the most important contribution ever made by an American to the science of sociology, is allowed to circulate among the students of our colleges and universities only in an expurgated form. Ideas certainly *are* dangerous things. The only available edition is that published by Ginn and Company (Boston). The complete work, as Sumner wrote it, has not yet been published.

Chapter 5

BIOLOGY

THE list of books in this chapter specifically relating to biology is necessarily so short that it can hope to accomplish only one particular purpose. That purpose is to give the reader some idea of the historical background of this branch of science. Even in this restricted field the list is far from complete. It constitutes only an introduction. But the

hors d'oeuvres are savory. Many important persons are necessarily omitted. Some of them are much more important than some of those included. But there are several reasons for the list as it stands. One is readability. And all of the important omitted names are discussed in one or more of the works cited.

37.* *Claudius Galenus. On the Natural Faculties.*

Every biological and medical student hears of Galen. Few read him. The most satisfactory edition readily available is that in the Loeb Classical Library, the translation being done by a medical man, Dr. Arthur John Brock. Since biology and medicine were, in considerable degree, inseparable in their origins this section may well begin with Galen.

38.* *Sir Michael Foster. Lectures on the History of Physiology during the Sixteenth, Seventeenth and Eighteenth Centuries.*

This is at once an authoritative and a delightful piece of historical writing. It conceives physiology broadly and starts with the founder of modern anatomy, Andreas Vesalius. With equal catholicity it reviews much of the more important part of the history of chemistry. Altogether it is a book which every young biologist ought to own as well as to read.

The lectures which constitute the book were given at the Cooper Medical College in San Francisco a quarter of a century ago. The book was published by the Cambridge University Press in 1901.

39.* *William Harvey. An Anatomical Disquisition on the Motion of the Heart and Blood in Animals.*

The Everyman edition (E. P. Dutton, New York) of this great classic is excellent. As Flourens said, this little treatise is "*le plus beau livre de la physiologie.*"

40.* *Robert Hooke. Micrographia: or some Physiological Descriptions of Minute Bodies made*

by Magnifying Glasses. With Observations and Inquiries thereupon.

Hooke is certainly one of the most entertainingly readable of the pioneer microscopists. Since the microscope is to biology what the telescope is to astronomy it is well to know something about how the start was made. Hooke was a man of great originality and versatility. Perhaps the latter quality is chiefly responsible for his name not being a greater one in the history of science than it is.
The *Micrographia* was published in 1667.

41.* *René Antoine Ferchault de Réaumur. The Natural History of Ants. Translated, with an Introduction and Notes, by William Morton Wheeler.*

Huxley said that he knew of no one who was to be placed in the same rank with Darwin as a naturalist except Réaumur. Last year Professor Wheeler discovered an unpublished manuscript in Réaumur's handwriting on ants. With a profundity and breadth

of learning which no other living biologist could approach, he has translated, edited, and annotated this delightful treatise. No better example could be found of the virtues inherent in simple observational natural history, a branch of scientific methodology now too much out of fashion.

The book contains the original French text, as well as the translation. The biographical introduction gives a fine picture of the state of biological science in the early eighteenth century. The book is published in New York (Alfred A. Knopf), 1926. It is beautifully printed.

42. *Charles Bonnet. Considérations sur les corps organisés.*

Bonnet was a *Privatgelehrte* who devoted his life to biology. He perhaps ought to be remembered primarily for the mass of careful, shrewd experimental work he did. But actually he stands out as the chief protagonist of the doctrine of preformation in the embryonic development of living things. It is well to look carefully into this doctrine because of the

extraordinary resemblance of the latest-day Mendelism to it. All orthodox Mendelians deny that their gospel is tainted with this ancient heresy, but I greatly fear that the verdict of an honest and philosophical judge would be against them, in some part at least.

My copy of the *Corps organisés* forms Tome III of the definitive edition of Bonnet's collected works (*Oeuvres d'histoire naturelle et de philosophie de Charles Bonnet.* Neuchatel, 1779).

43. *Casper Friedrich Wolff. Theoria Generationis.*

Casper Friedrich Wolff set embryology back on the epigenetic track where Aristotle had started it. The doctrine of epigenesis maintains that embryonic development is the result of the orderly action of internal and external forces upon initially homogeneous living substance. It would take us too far afield to discuss the history of the preformation *versus* epigenesis controversy. It is not settled yet. Every time biology gets into a comfortably steady state of ad-

herence to one of these doctrines, somebody comes forward with some new observations, demanding for their satisfactory rationalization a little borrowing from the other doctrine. The whole case has some aspects of parallelism to the present state of physics relative to the wave *versus* the quantum theories of light. But anyhow the student should read what Bonnet and Wolff had to say about the matter. The *Theoria generationis* is most readily available in the German translation by Paul Samassa published as Nos. 84 and 85 of Ostwald's *Klassiker der exakten Wissenschaften* (Engelmann).

44.* *Sir Charles Bell. The Hand: Its Mechanism and Vital Endowments as Evincing Design.*

We may now turn to the immediate predecessors of Darwin. It is well to note first the highly developed state which Natural Theology has attained in the first half of the nineteenth century. No better example can be found than this Bridgewater treatise. Of course all the Bridgewater treatises are interesting. If the present-day Fundamentalists were not

such a grossly ignorant lot they would seize upon these scholarly products of the noble Earl's bequest as their weapons to fight the biologists with, instead of relying upon such weak reeds as they do.

This particular volume in the set was published in London (William Pickering) in 1834. It is chosen for this list rather than some of the others partly because of its modest length, and partly because it is scientifically one of the best in the lot. Any man whose "discoveries as a whole must be regarded as the greatest in physiology since that of the circulation of the blood by William Harvey" is worth listening to today, even when he is mainly concerned with discussing a particular case of "the power, wisdom and goodness of God as manifested in the Creation."

45. *Jean Baptiste Pierre Antoine de Monet, Chevalier de Lamarck. Philosophie zoölogique.*

Just possibly Lamarck may have been more nearly right in his theory of the method of evolution than

it is fashionable now to believe. Biology has never been able to prove *conclusively* that he was not. There is a great deal of evidence to this effect, but it is negative in character, and not completely probative. The case being in such a state, surely the student ought to know at first hand what Lamarck really said. Because of certain defects of Lamarck as a naturalist, which go along with his excellencies, he is somewhat tiresome to read effectively in the original. It therefore seems justifiable to refer to two exegetical works. The best treatise on the significance of his work and his ideas is Marcel Landrieu's *Lamarck le fondateur du transformisme. Sa vie, son oeuvre,* published as Tome xxi of the *Mémoires de la Société Zoölogique de France* (Paris, 1909). A shorter and less technical, but authoritative, book is *Lamarck,* by Edmond Perrier, in *Les Grands Hommes de France,* published in Paris (Payot), 1926.

46.* *Charles Lyell. Principles of Geology, being an Attempt to Explain the Former Changes of the Earth's Surface, by Reference to Causes now in Operation.*

While labelled, and in fact, a textbook of geology, this great work is in no small degree a biological treatise. It is one of the most delightfully readable technical scientific books ever written. And the student of biology ought to know how far the doctrine of evolution had progressed just before the appearance of the *Origin of Species*. Naturally for this purpose it will be the first edition that one will read. This was intended to be in two volumes when it was begun, and the title page so announces. But before it was finished three volumes had become necessary. They were published in 1830, 1832, and 1833, by John Murray.

47.* *Charles Robert Darwin. The Origin of Species.*

No comment is needed, nor particular bibliographic citation.

48.* *Francis Galton. Natural Inheritance.*

A classic of biology and of statistics. The original edition was published in London and New York

(Macmillan), in 1889. This book embodies the first successful attempt ever made to *measure* the resemblances between human beings due to heredity.

49. *August Weismann. Essays upon Heredity and Kindred Biological Problems.*

Weismann carried the theory of natural selection to its completely logical end point, and put Lamarck where he belonged, at least where Weismann thought he belonged.
This handy volume of essays, which sufficiently expounds Weismann's ideas, was published, in the second edition, at Oxford (Clarendon Press), in 1891.

50. *William Bateson. Mendel's Principles of Heredity.*

The primary source of the dominant trend of biology today should certainly be read. The second edition (Cambridge University Press, 1909) of this book contains a great deal of early Mendelian work, now perhaps chiefly of historic interest, besides the

translation into English of Gregor Mendel's original papers.

51.* *Jean Louis Faure. Claude Bernard.*

This little volume gives the best account I know of the significance of the life and work of the great French physiologist. It will wisely guide the student to the reading of Claude Bernard's original writings.
It was published in Paris (G. Crès et Cie.), in 1925.

52.* *William Maddock Bayliss. Principles of General Physiology.*

Probably there is no other single book which so wisely, justly and philosophically sets forth what is known at this moment of the general principles of biology. I like best the original edition. It was published in London (Longmans, Green and Co.), 1915.

53.* *Edmund B. Wilson. The Cell in Development and Inheritance.*

Along with Bayliss' *General Physiology*, just cited, ranks Wilson's *Cell.* In my judgment they are the two best general biological *textbooks* ever written in any language.

The third edition of Wilson is the one to own. It was published in New York (Macmillan), 1925.

54.* *Paul De Kruif. Microbe Hunters.*

This history of bacteriology is an extraordinary book. It is written *con amore* by a specialist in the field. Anyone who starts to read it will do little else till it is finished. The book is published in New York (Harcourt, Brace and Co.), 1926. Some of the living persons discussed say that they have been unfairly treated in it.

55.* *Erik Nordenskiöld. Die Geschichte der Biologie.*

There has long been a great need for a systematic historical account of the development of biology. In my judgment the need is admirably met by

Nordenskiöld's book. It covers the ground adequately, is well-written, and, on the whole, is sound philosophically as well as historically. It is published in Jena (Gustav Fischer), 1926.

Chapter 6

BIOSTATISTICS

JUST as in the case of biology in the preceding chapter, the following list of books for the beginning student of vital statistics must be regarded as merely introductory. There are many important technical omissions. But it will do no harm to start along the outlined path. By the time it has been covered the traveller will be quite able to take care of himself on his further journey.

56.* *John Graunt. Natural and Political Observations Mentioned in a following Index, and made upon the Bills of Mortality. 1662.*

This is the first treatise on vital statistics. For student reading the extremely well-edited and annotated reprint of this classic in C. H. Hull's *The Economic Writings of Sir William Petty, etc.*, 1899, is the edition of choice.

57.* *Thomas Robert Malthus. Essay on the Principle of Population as it Affects the Future Improvement of Society.*

The Everyman Library edition, which is a reprint of the seventh edition of the original work, is excellent. Each edition of the *Essay*, however, was different from the others, and the collector will want them all.

58.* *Charles Robert Darwin. The Descent of Man.*

Vital statistics is a branch of human biology. For even more reasons than this the beginning biometrician should read this classic.

59. *J. Lottin. Quetelet — Statisticien et Sociologue.*

Quetelet was by no means the greatest man who ever lived. But he was an important link in the historical chain which binds vital statisticians of the present day to Laplace.

Lottin's adequate account of his life and work was published in Louvain and Paris (Alcan), 1912.

60.* *Alfred North Whitehead. An Introduction to Mathematics.*

This little treatise, published in 1911 in the *Home University Library* series (New York, Henry Holt & Co.) has served admirably two useful purposes in my laboratory ever since its appearance. First to dispel mathematicophobia when present, and second to demonstrate to the average student fresh from undergraduate mathematics, as taught in our colleges and universities, that the intellectual content of that subject extends beyond puzzle-solving.

61. *Isaac Todhunter. A History of the Mathematical Theory of Probability from the Time of Pascal to that of Laplace.*

To be regarded in all reverence, as the Bible (revised version) of the subject. It was published in 1865 in Cambridge and London (Macmillan) and has long been out of print. It commands a rather high price now and it is by no means easy to find a copy. It is, however, in most university libraries.

62. *Charles Santiago Sanders Peirce. A Theory of Probable Inference.*

This is a classic. No student of statistics can properly be said to have laid his basic foundations till he has mastered this essay.
It was originally published in *Studies in Logic by Members of the Johns Hopkins University.* Boston (Little, Brown and Company), 1883, pp. 126–181.

63. *William Farr. Vital Statistics: A Memorial Volume of Selections from the Reports and Writings of William Farr, M.D., D.C.L., C.B., F.R.S. Edited by Noel A. Humphreys.*

This may profitably be supplemented by delving in the Registrar General's Reports, because Hum-

phreys by no means extracted all the meat from the writings of the greatest medical statistician who has lived. The book was published by the Sanitary Institute of Great Britain (London, 1885) as a monument to Farr.

64.* *Francis Galton. Inquiries into Human Faculty and its Development.*

This is a statistical classic, as well as an entertaining book. It is readily procurable in Everyman's Library (E. P. Dutton, New York).

65.* *Knud Faber. Nosography in Modern Internal Medicine.*

An excellent brief history *not* of medicine but of medical *ideas*, published by Humphrey Milford, The Oxford University Press, in London in 1923.

66. *Erwin Baur, Eugen Fischer, Fritz Lenz. Menschliche Erblichkeitslehre.*

That the student may know something of the modern science of genetics in its relation to man.
The book is published in Munich (J. F. Lehmann), 1923.

67. *Julius Bauer. Die konstitutionelle Disposition zu inneren Krankheiten.*

That it may become even clearer that genetics has relation to medicine. This valuable treatise, which has gone through several editions, is published by Julius Springer, in Berlin.

68. *William George MacCallum. A Text Book of Pathology.*

So that if our student becomes a practicing vital statistician he may have a less vague notion than he otherwise might of the objective realities which lie behind the statements as to the causes of death which appear upon death certificates. MacCallum's book is published by W. B. Saunders Company, of Philadelphia.

69.* *William Travis Howard, Jr. Public Health Administration and the Natural History of Disease in Baltimore, Maryland, 1797–1920.*

To the end that the time base and other elements of his thinking about public health problems may be expanded, if by chance our student is interested in public health.

This volume is Publication No. 351, of the Carnegie Institution of Washington, and was published in 1924.

70. *George Udny Yule. An Introduction to the Theory of Statistics.*

This book ends the list, not because the student will not have made contact with it sooner, but because it will be desirable to reread at this terminal stage a book which in my judgment embodies and exemplifies, in a degree that no other I know of does, a sound, well-ripened philosophy of the statistical method.

The seventh edition was published in London (Griffin), 1924.

Chapter 7

EPILOGUE

LITTLE needs to be said in conclusion. Doubtless this list of reading will be violently criticized by some. But so probably would any other list. The real test of its value is the effect which the books in it produce upon the minds of those who read them. As to the outcome of such a test I am not in the least worried.

My position agrees with that of Lubbock, who says: "Another objection has been made that every one should be left to choose for himself. And so he must. No list can be more than a suggestion. But a great literary authority can hardly perhaps realize the difficulty of selection. An ordinary person turned into a library and sarcastically told to choose for himself, has to do so almost at haphazard. He may perhaps light upon a book with an attractive title, and after wasting on it much valuable time and patience, find that, instead of either pleasure or profit, he has weakened, or perhaps lost, his love of reading."

I realize keenly the deficiencies in my list. They are perhaps most easily noticed in Chapter IV. Nothing is said about music, the graphic arts, or gastronomy so far as concerns food as distinguished from drink, all important elements in the art of living. My plea in extenuation is lack of space, coupled with the following considerations. It has always seemed to me a great deal more fun to listen to music, or to make it myself, poor a performer as I am, than to read about it. The same idea applies to pictures. For purely technical ends I possess a small but fairly adequate library of books dealing with prints. But I enjoy the contemplation of the actual engravings and etchings in my collection infinitely more than I do reading the most charming book ever written *about* prints.

Regarding the art of gastronomy the difficulty is of a different sort. Here the beginner certainly needs guidance and technical instruction towards the foundation of a sound taste. But I know of no treatise on the subject which I am prepared to recommend unreservedly. Naturally Brillat-Savarin's *La Physiologie du Gout,* containing his meditations on what

he was pleased to call " transcendental gastronomy," will occur to everyone. Indeed I have been urged by some of my friends to include this book in the list. But after careful deliberation I have decided against it. The fame of Brillat-Savarin's treatise, I think, rests in large part upon the fact that the field has been but little cultivated. It is like the kingship of the one-eyed man in a realm of the blind. The truly great book on gastronomy is yet to be written. There is much that is fine in Brillat-Savarin, but also there is a great deal of cheap and wholly irrelevant philosophy. A much better treatise on the subject, in fact I believe the best one in existence at the moment, is the series, in twenty odd volumes, by Curnonsky and Marcel Rouff called *La France Gastronomique. Guide des merveilles et des bonnes auberges françaises* (Paris: Rouff). Its chief virtue is also its chief defect. It treats only of French gastronomy. But perhaps, on the whole, the virtues of provincialism outweigh the disadvantages in this case. For, taken by and large, French food is undoubtedly the best in the world. In gastronomy, as in a number of other respects, the French are the

leaders of civilization. And the amiable Curnonsky and Marcel are thoroughly practical guides.

Another regrettable omission is of specifically and technically religious treatises. I confess to an increasing fondness for religious and theological literature as I grow older. But this taste, I am sure, is only an expression of advancing senility. The young would get no such pleasure out of holy writings. Since this book is primarily intended as a prophylactic rather than a curative medicine, and must therefore be administered early, I have thought it best not to incorporate the evidences of so curious a literary taste in the body of the list.

At the same time, of course, youth ought to have religious as well as gastronomic guidance in the matter of conducting life. To this end I suggest five books, to be read in the order named.

This Believing World, by Lewis Browne, published in New York (Macmillan), 1926.

Sex Symbolism in Religion, by J. B. Hannay, a book privately printed in two volumes for The Religious Evolution Research Society (20 Buckingham Street, Strand, London, W. C. 2), 1922.

Is it God's Word?, by Joseph Wheless, published in New York (Alfred A. Knopf, Inc.), 1926.

A Dictionary of Saintly Women, by Agnes B. C. Dunbar, published in two volumes in London (G. Bell and Sons), 1904.

A History of the Warfare of Science with Theology in Christendom, by Andrew Dickson White. The latest edition was published in New York (D. Appleton and Co.), 1923, 2 volumes.

When the student has read these five books his religious education will have been well attended to. More could of course be added by way of ornamentation. But a sound foundation will have been laid.

I fear that this modest treatise will be criticized by some through a misunderstanding. It will be alleged that a number of the included books are greatly surpassed in literary merit, by others that might have been chosen. Thus *La Rotisserie de la Reine Pédauque* is, from a literary point of view, perhaps the greatest book that Anatole France ever wrote. But, as I have already said in an earlier chapter, the underlying aim and motive in this list is *not* literary.

I have been primarily concerned with quite other ends.

Having regard to strict adherence to these ends my experience has again been similar to Lubbock's: "I have no doubt that on reading the list, many names of books which might well be added would occur to almost any one. Indeed, various criticisms on the list have appeared, and many books have been mentioned which it is said ought to have been included. On the other hand no corresponding omissions have been suggested. I have referred to several of the criticisms, and find that, while 300 or 400 names have been proposed for addition, only half a dozen are suggested for omission. Moreover, it is remarkable that not one of the additional books suggested appears in all the lists, or even in half of them, and only about half a dozen in more than one."

NUNC DIMITTIS

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